Optimized Profile Descent (OPD) Site Evaluations and Benefits Analysis

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Integration of Procedures

- FAA's RNAV and RNP Group and Airspace Strategy
- Integration of Procedures
  - Consists of 4 design methods
    - Optimized Profile Descents
    - SID/STAR concurrent design and implementations
    - Decoupling of adjacent airport flows
    - City-pair combinations (SID, enroute, STAR, approach)

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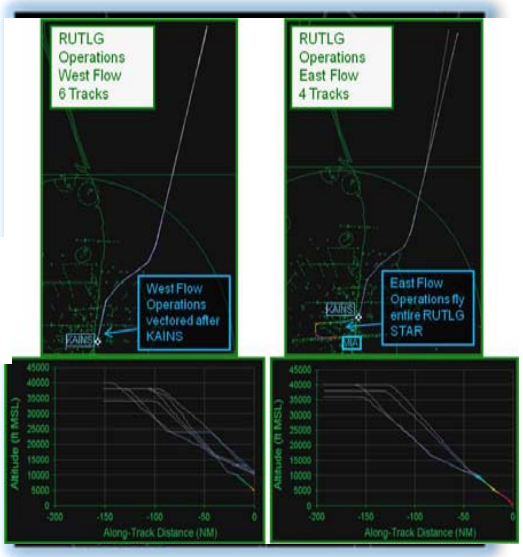
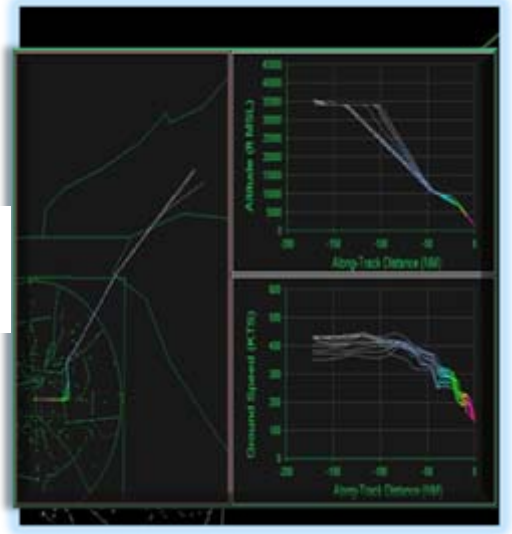
Background
OPD Demonstrations at ATL and MIA

MIA Flights Analysis



ATL Flights Analysis



- Atlantic Interoperability Initiative to Reduce Emissions (AIRE) – Signed June 07
- Administrator's Goal: "Complete demos at ATL and MIA by May 08" (AJP and AJR collaboration)
- FAA, Industry, and CAASD teams formed for ATL and MIA.
  - Kickoff meeting occurred in Sept. 07
  - 20+ demo flights flown at ATL and MIA in May 08
  - Savings: Fuel (48-52 gals/flt.), CO2 (460-497 kg/flt.)
- ATL and MIA continue plans for greater use and operational impact mitigations
- Hank Krakowski and Joe McCarthy briefed Mr. Sturgell in July, he said accelerate!
- FY09 – CAASD analysis to enable FAA site prioritization. Followed by site modeling, analysis procedure design and implementation tasks in FY09 and FY10.

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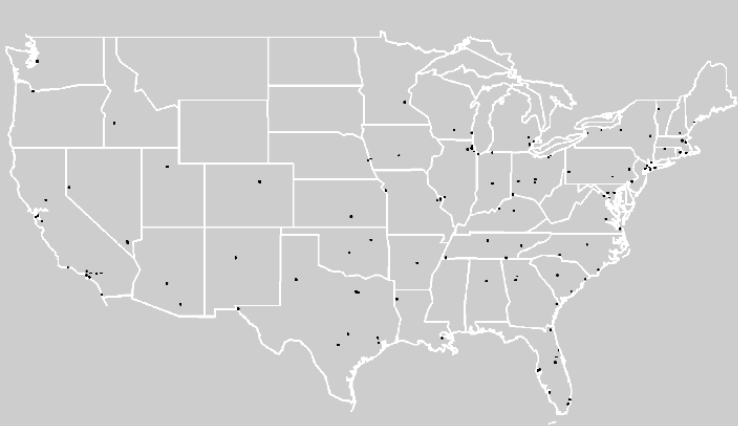
Site Analysis Overview

- **Description:**
  - **A data-driven methodology for prioritizing OPD implementation sites**
  - **Ranks sites in 3 categories:**
    - **a) High Relative Benefits** – *Higher degree of procedure design difficult and longer lead times*
    - **b) Moderate Relative Benefits** - lower degree of design c*omplexity, shorter lead times*
    - **c) PBN Implementation Status** – Sites within FAA and/or Industry existing RNAV plans

- **Offers a flexible foundation for OPD site prioritization**
  - **Enables FAA/Industry decision making**
  - **Enables site prioritization based on arrival flows**
  - **Site-specific analysis provides advanced information on specific arrival flows**

Candidate Airports

- Analyzed 1800 airports
- Filtered based on operational statistics:
  - IFR arrival count greater than 40 per day
  - More than 35% jet or commercial traffic
- Model addresses:
  - 118 airports
  - 4091 arrival flows
    - Lateral and vertical track analysis for specific arrival flows and runways



Geographical distribution of 118 candidate airports

ABE	Allentown PA	FRG	Long Island, NY	PDK	Peachtree, GA
ABQ	Albuquerque, NM	GAI	Gaithersburg, MD	PDX	Portland, OR
ALB	Albany, NY	GYY	Gary, IN	PHL	Philadelphia, PA
ALN	Alton, IL	HND	Henderson, NV	PHX	Phoenix, AZ
ATL	Atlanta, GA	HOU	Houston, TX	PIE	Portland, OR
AUS	Austin, TX	HPN	Westchester, NY	PIT	Pittsburgh, PA
BDL	Hartford, CT	IAD	Washington, DC	PTK	Pontiac, MI
BED	Bedford, MA	IAH	Houston, TX	PVD	Providence, RI
BFI	King County, WA	ICT	Wichita, KS	PWK	Pal Waukee, IL
BHM	Birmingham, AL	ILM	Wilmington, NC	PWM	Portland, ME
BKL	Cleveland, OH	IND	Indianapolis, ID	RDU	Raleigh-Durham, NC
BNA	Nashville, TN	JAX	Jacksonville, FL	RIC	Richmond, VA
BOI	Boise, ID	JFK	New York, NY	RNO	Reno, NV
BOS	Boston, MA	LAS	Las Vegas, NV	RNT	Renton, WA
BTV	Burlington, VT	LAX	Los Angeles, CA	ROC	Rochester, NY
BUF	Buffalo, NY	LBB	Lubbock, TX	RSW	Fort Myers, FL
BUR	Burbank, CA	LCK	Columbus, OH	SAN	San Diego, CA
BWI	Baltimore, MD	LEX	Lexington, KY	SAT	San Antonio, TX
CAE	Columbia, SC	LGA	LaGuardia, NY	SAV	Savannah, GA
CHA	Chattanooga, TN	LGB	Long Beach, CA	SBA	Santa Barbara, CA
CHS	Charleston, SC	LIT	Little Rock, AR	SBD	San Bernardino, CA
CLE	Cleveland, OH	MCI	Kansas City. MO	SBN	South Bend, IN
CLT	Charlotte, NC	MCO	Orlando, FL	SDF	Louisville, KY
CMH	Columbus, OH	MDT	Harrisburg, PA	SEA	Seattle, WA
CVG	Cincinnati, OH	MDW	Chicago, IL	SFB	Orlando, FL
DAB	Daytona Beach, Fl	MEM	Memphis, TN	SFO	San Francisco, CA
DAL	Dallas, TX	MHT	Manchester, NH	SHV	Shreveport, LA
DAY	Dayton, OH	MIA	Miami, FL	SJC	San Jose, CA
DCA	Washington, DC	MKE	Milwaukee, WI	SLC	Salt Lake City, UT
DEN	Denver, CO	MLE	Millard, NE	SMF	Sacramento, CA
DET	Detroit, MI	MSN	Madison, WI	STL	St. Louis, MO
DFW	Dallas, TX	MSP	Minneapolis, MN	SUS	St. Louis, MO
DPA	Du Page, IL	MSY	New Orleans, LA	SYR	Syracuse, NY
DSM	Des Moines, IL	MYR	Myrtle Beach, SC	TEB	Teterboro, NY
DTW	Detroit, MI	OAK	Oakland, CA	TPA	Tampa, FL
ELP	El Paso, TX	OKC	Oklahoma City, OK	TUL	Tulsa, OK
EMT	El Monte, CA	OMA	Omaha, NE	TUS	Tucson, AZ
EWB	New Bedford, MA	ONT	Ontario, CA	TYS	Knoxville, TN
EWR	Newark, NJ	ORD	Chicago, IL		
FLL	Fort Lauderdale, FL	ORF	Norfolk, VA		

Alphabetical list of 118 candidate airports

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Category “A” Airports

a) High Relative Benefit

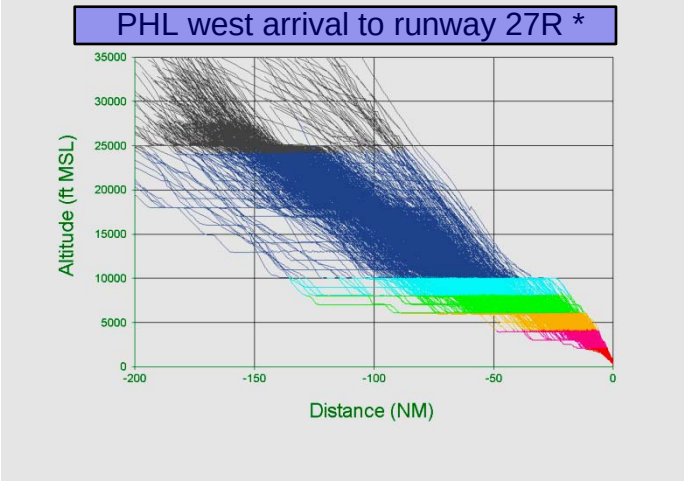
- Ranks sites by benefit potential - fuel and emission savings
- Arrival flows that top this list tend to have ***many operations***, ***high percentage of commercial or jet traffic***, and ***numerous long level-offs***

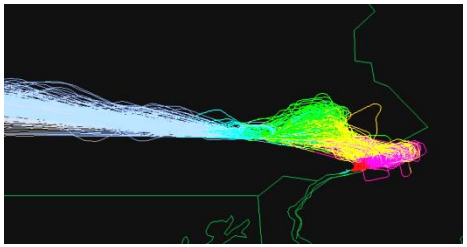
Average daily arrival count along flow *	Percent Part121 Ops at the airport **	Percent Jet Ops at the airport **	Time in level flight per aircraft along flow *
142 arrivals	76%	84%	585 s

Site Impact and Relative Benefit

Rank	Airport
1	PHL – Philadelphia, PA
2	ORD – Chicago, IL
3	EWR – Newark, NJ
4	LGA – New York, NY
5	IAH – Houston, TX
6	DTW – Detroit, MI
7	DFW – Dallas, TX
8	CVG – Cincinnati, OH
9	IAD – Washington, DC
10	DCA – Washington, DC

trend reversal





* Based on radar tracks from 7 NAS-wide VMC days in 2007

** Based on ETMS data 1st Quarter 2008

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Category “B” Airports

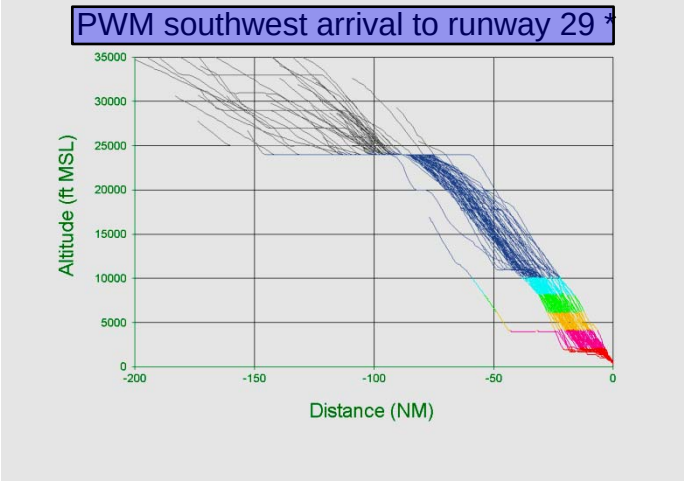
b) Moderate Relative Benefits

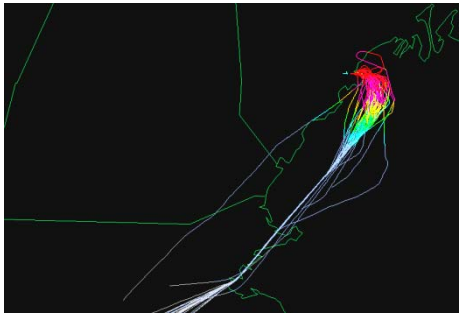
- Ranks sites based on lower complexity of Implementation
  - Expected faster time to the field, greater numbers of procedures in the NAS
- Arrival flows that top this list have *lower controller workload*, *fewer hand-offs*, *fewer level-offs*, and *less vectoring*

Average daily arrival count at airport **	Average number of centers along flow *	Average number of level-offs along flow *	Percent vectoring along flow *
91 arrivals	1	1	24%

Complexity of Implementation	
Rank	Airport
1	PWM – Portland, ME
2	MSN – Madison, WI
3	RNO – Reno, NV
4	JAX – Jacksonville, FL
5	PVD – Providence, RI
6	DAY – Dayton, OH
7	RSW – Fort Myers, FL
8	MSY – New Orleans, LA
9	AUS – Austin, TX
10	ROC – Rochester, NY

Increasing Complexity





* Based on radar tracks from 7 NAS-wide VMC days in 2007

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Category “C” Airports

c) PBN Implementation Status

- **Ranks airports by how prepared the site is to begin planning**
  - Identifies sites that have stakeholder awareness for RNAV implementation
  - Sites within FAA existing RNAV plans
- **Airports that top this list have *high RNAV equipage* rates and are *scheduled for procedure design* in the following years**

Resource Readiness	
Rank	Airport
1	BWI – Baltimore, MD
2	ATL – Atlanta, GA
3	CVG – Cincinnati, OH
4	RDU – Raleigh-Durham, NC
5	MHT – Manchester, NH
6	BUR – Burbank, CA
7	BOS – Boston, MA
8	PWM – Portland, ME
9	MEM – Memphis, TN
10	PIT – Pittsburgh, PA

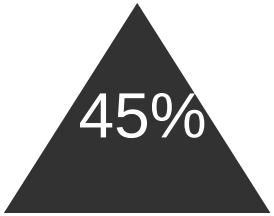
Increasing Interest

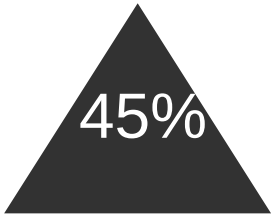
Airport	RNAV equipage rate **	Chart date *
BWI	94%	SID 4/8/2010
ATL	91%	STAR 2/11/2010
CVG	90%	SID 10/22/2009
RDU	88%	STAR 4/8/2010

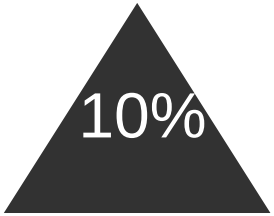
*** NAPT Production Schedule February 2009**
**** Based on ETMS data 1st Quarter 2008**

Compiling a Single List

- **Place weights on the metric categories:**
  - **Weights can be chosen to reflect implementation priorities**
  - **Priority decisions can be based on a mix of complexity, benefit, and readiness:**
  - **Example:**







a) High Relative Benefits

Rank	Airport
1	PHL – Philadelphia, PA
2	ORD – Chicago, IL
3	EWR – Newark, NJ
4	LGA – New York, NY
5	IAH – Houston, TX
6	DTW – Detroit, MI
7	DFW – Dallas, TX
8	CVG – Cincinnati, OH
9	IAD – Washington, DC
10	DCA – Washington, DC

b) Moderate Relative Benefits

Rank	Airport
1	PWM – Portland, ME
2	MSN – Madison, WI
3	RNO – Reno, NV
4	JAX – Jacksonville, FL
5	PVD – Providence, RI
6	DAY – Dayton, OH
7	RSW – Fort Myers, FL
8	MSY – New Orleans, LA
9	AUS – Austin, TX
10	ROC – Rochester, NY

c) PBN Implementation Status

Rank	Airport
1	BWI – Baltimore, MD
2	ATL – Atlanta, GA
3	CVG – Cincinnati, OH
4	RDU – Raleigh-Durham, NC
5	MHT – Manchester, NH
6	BUR – Burbank, CA
7	BOS – Boston, MA
8	PWM – Portland, ME
9	MEM – Memphis, TN
10	PIT – Pittsburgh, PA

Sample Prioritized List

- **Weighting**
  - **Emphasis on:**
    - **a) High Relative Benefits** (45%)
    - **b) Moderate Relative Benefits** (45%)
    - **c) PBN Implementation Status** (10%)
  - **Different weighting systems can emphasize different priorities**
- **What is the benefit potential at the first 10 sites on this list?**

45% Complexity, 45% Benefit, 10% Resource	
Rank	Airport
1	STL – St. Louis, MO
2	MHT– Manchester, NH
3	PIT – Pittsburgh, PA
4	CVG – Covington, KY
5	RDU – Raleigh-Durham, NC
6	FLL – Fort Lauderdale, FL
7	PHX – Phoenix, AZ
8	MCO – Orlando, FL
9	SAN – San Diego, CA
10	SLC – Salt Lake City, UT
11	RSW - Fort Myers, FL
12	BNA – Nashville, TN
13	CLE – Cleveland, OH
14	CMH – Columbus, OH
15	TUS – Tucson, AZ
16	SAT - San Antonio, TX
17	SDF - Louisville, KY
18	PWM – Portland, ME
19	JAX – Jacksonville, FL
20	BOS – Boston, MA
21	MCI - Kansas City, MO
22	LAS – Las Vegas, NV
23	BUR - Burbank, CA
24	MEM – Memphis, TN
25	TPA - Tampa, FL

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Benefits Analysis

- **Benefit analysis**
- **Operational data from these 10 airports combined with benefits estimates yield significant monetary and carbon savings**

Composite 45/45/10 List	
Rank	Airport
1	STL – St. Louis, MO
2	MHT – Manchester, NH
3	PIT – Pittsburgh, PA
4	CVG – Covington, KY
5	RDU – Raleigh-Durham, NC
6	FLL – Fort Lauderdale, FL
7	PHX – Phoenix, AZ
8	MCO – Orlando, FL
9	SAN – San Diego, CA
10	SLC – Salt Lake City, UT

	5 gal per flight	15 gal per flight
Savings (Gal/day)	7324	21973
$3 / Gal ($/day)	$21,973	$65,919
Annual Savings	$8,020,093	$24,060,279
CO2 Reduction (tons/year)	26734	80201
Cars off road (cars / year)	4456	13367
Cumulative savings: 2010-2035	$200,502,321	$601,506,964

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OPD Benefits Analysis
Top Ten Airports

- **Benefit analysis**
- **Operational data from these 10 airports combined with benefits estimates yield significant monetary and carbon savings**

Top Ten of the 34 continental OEP Airports, by Traffic Volume	
Rank	**Airport**
1	ATL – Atlanta, GA
2	ORD – Chicago, IL
3	DFW – Dallas, TX
4	DEN – Denver, CO
5	LAX – Los Angeles, CA
6	IAH – Houston, TX
7	CLT – Charlotte, NC
8	PHL – Philadelphia, PA
9	EWR – Newark, NJ
10	PHX– Phoenix, AZ

	5 gal per flight	15 gal per flight
Savings (Gal/day)	11947	35841
$3 / Gal ($/day)	$35,841	$107,524
Annual Savings	$13,082,121	$39,246,364
CO2 Reduction (tons/year)	43607	130821
Cars off road (cars / year)	7268	21804
Cumulative savings: 2010-2035	$327,053,036	$981,159,107

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Summary

- OPDs can produce significant cost and environmental savings
- Cross agency and industry collaboration
- We are work locations today like CHS, SDF, LAX, STL
- Model provides a means to use operational data for prioritization and benefits assessments
- MITRE to enhance the analysis and reporting capability
  - more detailed analysis and sites
- Next Steps
  - Create a consolidated list based on EC priority and lines of business
  - Coordinate with Industry – PARC, CNS TF, JPDO EWG, etc.

NOTE: Implementation risks include environmental studies, facility readiness and site specific airspace design/re-design

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